

What is claimed is:

1. A retroreflective sheeting that comprises:

5 (a) a body portion that has first and second major surfaces and that includes a body layer of polymeric material that has an elastic modulus less than 7×10^8 pascals, the body layer allowing light that enters the body portion through either the first or the second major surfaces to pass through the body layer to exit the body portion through the other major surface; and

10 (b) cube-corner elements that project from the second major surface of the body portion such that light that exits the body portion through the second major surface enters the cube-corner elements where it is reflected to reenter the body portion, the cube-corner elements containing a polymeric material that has an elastic modulus greater than the body layer to such an extent that the retroreflective sheeting does not exhibit a substantial loss of retroreflectivity when flexed.

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1. The retroreflective sheeting of claim 1, wherein the cube-corner elements contain a polymeric material that has an elastic modulus that is at least 9×10^8 pascals greater than the elastic modulus of the body layer.

20 2. The retroreflective sheeting of claim 1, wherein the cube-corner elements contain a polymeric material that has an elastic modulus that is at least 11×10^8 pascals greater than the elastic modulus of the body layer.

25 3. The retroreflective sheeting of claim 1, wherein the cube-corner elements contain a polymeric material that has an elastic modulus that is at least 13×10^8 pascals greater than the elastic modulus of the body layer.

4 4. The retroreflective sheeting of claim 1, wherein the body portion includes a land layer that has a thickness in the range of 0 to 150 micrometers and is comprised of a light transmissible polymeric material having an elastic modulus greater than 16×10^8 pascals.

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3. 6. The retroreflective sheeting of claim 5, wherein the land layer has a thickness of 1 to 100 micrometers.

4. 7. The retroreflective sheeting of claim 6, wherein the cube-corner elements and land layer comprise a polymer(s) that has an elastic modulus greater than 18×10^8 pascals.

5. 8. The retroreflective sheeting of claim 1, wherein the body layer has a thickness of approximately 20 to 1,000 micrometers.

6. 9. The retroreflective sheeting of claim 8, wherein the body layer has a thickness of 50 to 250 micrometers.

7. 10. The retroreflective sheeting of claim 9, wherein the cube-corner elements have a height of about 60 to 180 micrometers.

8. 11. The retroreflective sheeting of claim 1, wherein the cube-corner elements comprise a polymeric material having an elastic modulus of greater than 18×10^8 pascals.

9. 12. The retroreflective sheeting of claim 11, wherein the cube-corner elements comprise a light transmissible polymeric material having a elastic modulus greater than 20×10^8 pascals.

10. 13. The retroreflective sheeting of claim 1, wherein the cube-corner elements contain poly(carbonate), poly(methylmethacrylate), poly(ethyleneterephthalate), or a crosslinked acrylate.

11. 14. The retroreflective sheeting of claim 13, wherein the body portion includes a land layer that comprises the same polymeric material as the cube-corner elements.

14 15. The retroreflective sheeting of claim 1, wherein the body layer contains a light transmissible polymeric material having an elastic modulus less than 5×10^8 pascals.

15 5 16. The retroreflective sheeting of claim 15, wherein the body layer contains a light transmissible polymeric material that has an elastic modulus less than 3×10^8 pascals.

16 10 17. The retroreflective sheeting of claim 1, wherein the body layer contains: an ethylene copolymer that contains units that contain carboxyl groups or esters of carboxylic acids, ionomeric ethylene copolymers; plasticized poly(vinylchloride); an aliphatic urethane or combinations thereof.

17 15 18. The retroreflective sheeting of claim 17, wherein the body layer contains aliphatic urethanes that contain: units of polyester glycol, polyether glycol, polycarbonate glycol, poly-1,2-butylene oxide glycol, or combinations thereof; and units of dicyclohexylmethane-4,4'-diisocyanate, isophorone diisocyanate, 1,6-hexamethylene diisocyanate, cyclohexyl diisocyanate, or combinations thereof.

18 20 19. The retroreflective sheeting of claim 17, wherein the ethylene copolymers that contain units that contain carboxyl groups or esters of carboxylic acids are selected from the group consisting of poly(ethylene-co-acrylic acid), poly(ethylene-co-methacrylic acid), poly(ethylene-co-vinylacetate), and combinations thereof.

19 25 20. The retroreflective sheeting of claim 1, wherein the body layer contains a light transmissible polymeric material having a thickness of 50 to 250 micrometers and an elastic modulus of less than 5×10^8 pascals, and the plurality of cube-corner elements contain a light-transmissible polymeric material having an elastic modulus greater than 18×10^8 pascals.

21. The retroreflective sheeting of claim 20, wherein the body layer contains a polymer selected from the group consisting of poly(ethylene-co-acrylic acid), poly(ethylene-co-methacrylic acid), poly(ethylene-co-vinyl acetate), an ionomeric ethylene copolymer, and an aliphatic urethane; and wherein the cube-corner elements contain a polymer selected from the group consisting of poly(carbonate), poly(methylmethacrylate), poly(ethyleneterephthalate), and crosslinked acrylates.

22. The retroreflective sheeting of claim 21, wherein the body layer comprises poly(ethylene-co-acrylic acid) or poly(ethylene-co-methacrylic acid), and the cube-corner elements contain polycarbonate.

23. The retroreflective sheeting of claim 22, wherein the body portion includes a land layer that contains polycarbonate, and further comprises a tie layer disposed between the body layer and land layer, which tie layer contains an aliphatic polyurethane.

24. The retroreflective sheeting of claim 1, wherein the body layer provides significant mechanical integrity to the retroreflective article, and contains ultra-violet light absorbers, light stabilizers, free radical scavengers, or combinations thereof.

25. The retroreflective sheeting of claim 1, wherein the cube-corner elements have a height of about 20 to 500 micrometers and contain a polymeric material that has an elastic modulus of greater than about 16×10^8 pascals.

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10 26. A retroreflective sheeting that comprises:

(a) a body portion that has first and second major surfaces and that includes a

body layer of polymeric material that has an elastic modulus less than 7×10^8 pascals, the body

layer) allowing light that enters the layer through either the first or the second major surfaces to pass through the layer to exit the sheeting through the other major surface; and

(b) cube-corner elements that project from the second major surface of the body portion layer such that light that exits the body layer through the second major surface enters the cube-corner elements where it is reflected to reenter the body layer, the cube-corner elements containing a polymeric material that has an elastic modulus that is at least 9×10^8 pascals greater than the elastic modulus of the body layer.

15 27. The retroreflective sheeting of claim 26, wherein the cube-corner elements contain a polymeric material that has an elastic modulus that is at least 11×10^8 pascals greater than the elastic modulus of the body layer.

20 28. The retroreflective sheeting of claim 26, wherein the cube-corner elements contain a polymeric material that has an elastic modulus that is at least 13×10^8 pascals greater than the elastic modulus of the body layer.

25 29. The retroreflective sheeting of claim 26, wherein the cube-corner elements and land layer comprise a polymer(s) that has an elastic modulus greater than 18×10^8 pascals.

30 30. The retroreflective sheeting of claim 26, wherein the body layer has a thickness of approximately 20 to 1,000 micrometers, and wherein the cube-corner elements have a height of about 60 to 180 micrometers.

30 31. The retroreflective sheeting of claim 26, wherein the cube-corner elements comprise a light transmissible polymeric material having a elastic modulus greater than 18×10^8 pascals.

31 10 32. The retroreflective sheeting of claim 26, wherein the cube-corner elements contain poly(carbonate), poly(methylmethacrylate), poly(ethyleneterephthalate), or a crosslinked acrylate.

32 12 33. The retroreflective sheeting of claim 26, wherein the body layer contains a light transmissible polymeric material having an elastic modulus less than 5×10^8 pascals.

33 13 34. The retroreflective sheeting of claim 26, wherein the body layer contains a light transmissible polymeric material that has an elastic modulus less than 3×10^8 pascals.

34 14 35. The retroreflective sheeting of claim 26, wherein the body layer contains: an ethylene copolymer that contains units that contain carboxyl groups or esters of carboxylic acids, ionomeric ethylene copolymers; plasticized poly(vinylchloride); an aliphatic urethane or combinations thereof.

35 16 36. The retroreflective sheeting of claim 35, wherein the ethylene copolymers that contain units that contain carboxyl groups or esters of carboxylic acids are selected from the group consisting of poly(ethylene-co-acrylic acid), poly(ethylene-co-methacrylic acid), poly(ethylene-co-vinylacetate), and combinations thereof.

36 18 37. The retroreflective sheeting of claim 26, wherein the body layer contains a polymer selected from the group consisting of poly(ethylene-co-acrylic acid), poly(ethylene-co-methacrylic acid), poly(ethylene-co-vinyl acetate), an ionomeric ethylene copolymer, and an aliphatic urethane; and wherein the cube-corner elements contain a polymer selected from the group consisting of poly(carbonate), poly(methylmethacrylate), poly(ethyleneterephthalate), and crosslinked acrylates.

37 19 38. The retroreflective sheeting of claim 37, wherein the body layer comprises poly(ethylene-co-acrylic acid) or poly(ethylene-co-methacrylic acid), and the cube-corner elements contain polycarbonate.

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7 39. The retroreflective sheeting of claim 26, wherein the cube-corner elements have a height of about 20 to 500 micrometers and contain a polymeric material that has an elastic modulus of greater than about 16×10^8 pascals.

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